

CLAIMS:

1. A copolymer formed by polymerizing propylene, 4-methyl-1-pentene, styrene, or another C₄₋₂₀ α -olefin, and a copolymerizable comonomer in the presence of a composition comprising the admixture or reaction product resulting from combining:

5 (A) a first olefin polymerization catalyst,

(B) a second olefin polymerization catalyst capable of preparing polymers differing in chemical or physical properties from the polymer prepared by catalyst (A) under equivalent polymerization conditions, and

(C) a chain shuttling agent.

10 2. A copolymer formed by polymerizing propylene, 4-methyl-1-pentene, styrene, or another C₄₋₂₀ α -olefin, and a copolymerizable comonomer in the presence of a composition comprising the admixture or reaction product resulting from combining:

(A) a first olefin polymerization catalyst having a high comonomer incorporation index,

15 (B) a second olefin polymerization catalyst having a comonomer incorporation index less than 95 percent of the comonomer incorporation index of catalyst (A), and

(C) a chain shuttling agent.

3. A process for preparing a propylene containing multi-block copolymer comprising contacting propylene and one or more addition polymerizable comonomer other than propylene under addition polymerization conditions with a composition comprising:

20 the admixture or reaction product resulting from combining:

(A) a first olefin polymerization catalyst,

(B) a second olefin polymerization catalyst capable of preparing polymers differing in chemical or physical properties from the polymer prepared by catalyst (A) under equivalent polymerization conditions, and

25 (C) a chain shuttling agent.

4. A process according to claim 3 wherein the comonomer is ethylene.

5. A process for preparing a 4-methyl-1-pentene containing multi-block copolymer comprising contacting 4-methyl-1-pentene and one or more addition polymerizable comonomers other than 4-methyl-1-pentene under addition polymerization conditions with a composition
30 comprising:

the admixture or reaction product resulting from combining:

(A) a first olefin polymerization catalyst,

(B) a second olefin polymerization catalyst capable of preparing polymers differing in chemical or physical properties from the polymer prepared by catalyst (A) under equivalent
35 polymerization conditions, and

(C) a chain shuttling agent.

6. A process according to claim 5 wherein the comonomer is ethylene.

7. A multi-block copolymer comprising in polymerized form two monomers selected from the group consisting of C₂₋₂₀ α -olefins, said copolymer containing therein two or more segments or
5 blocks differing in comonomer content, crystallinity, tacticity, homogeneity or density, and at least one of the polymer blocks consisting essentially of polymerized propylene, 4-methyl-1-pentene, styrene, or other C₄₋₂₀ α -olefin.

8. A multi-block copolymer comprising in polymerized form propylene and ethylene, or 4-methyl-1-pentene and ethylene, said copolymer containing therein two or more segments or blocks
10 differing in comonomer content, crystallinity, tacticity, homogeneity or density.

9. A multi-block copolymer consisting essentially of propylene and ethylene or 4-methyl-1-pentene and ethylene in polymerized form, said copolymer containing therein two or more segments or blocks differing in comonomer content, crystallinity, tacticity, homogeneity or density.

10. A multi-block copolymer according to any one of claims 5-9 containing therein four or
15 more segments or blocks differing in comonomer content, crystallinity, tacticity, homogeneity, or density.

11. A functionalized derivative of the multi-block copolymer of any one of claims 1, 2, 5-9 or made by the process of claim 3 or 4.

12. A functionalized derivative of the multi-block copolymer of claim 10.

20 13. A homogeneous polymer mixture comprising: (1) an organic or inorganic polymer and (2) a multi-block copolymer according to any one of claims 1, 2, 5-9 or made by the process of claim 3 or 4 of the present invention.

14. A crosslinked derivative of a polymer according to any one of claims 1, 2, 5-9 or made by the process of claim 3 or 4.

25 15. A crosslinked derivative of a polymer according to claim 10.

16. A crosslinked derivative of a polymer according to claim 11.

17. A crosslinked derivative of a polymer according to claim 12.

18. A polymer according to any one of claims 1, 2, 5-9 or made by the process of claim 3 or 4, or a composition comprising the same in the form of a film, at least one layer of a multilayer
30 film, at least one layer of a laminated article, a foamed article, a fiber, a nonwoven fabric, an injection molded article, a blow molded article, a roto-molded article, or an adhesive.

19. A polymer according to claim 14 or a composition comprising the same in the form of a film, at least one layer of a multilayer film, at least one layer of a laminated article, a foamed article, a fiber, a nonwoven fabric, an injection molded article, a blow molded article, a roto-molded article,
35 or an adhesive.

20. A polymer according to claim 15 or a composition comprising the same in the form of a film, at least one layer of a multilayer film, at least one layer of a laminated article, a foamed article, a fiber, a nonwoven fabric, an injection molded article, a blow molded article, a roto-molded article, or an adhesive.

21. A polymer according to claim 16 or a composition comprising the same in the form of a film, at least one layer of a multilayer film, at least one layer of a laminated article, a foamed article, a fiber, a nonwoven fabric, an injection molded article, a blow molded article, a roto-molded article, or an adhesive.

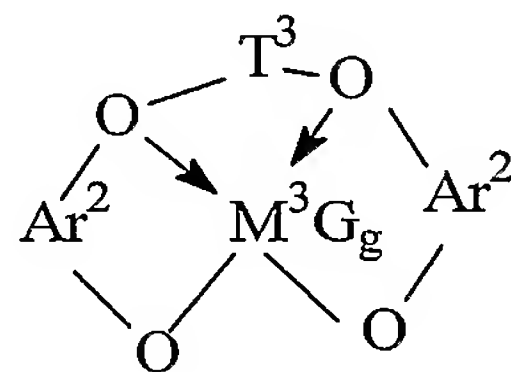
22. A polymer according to claim 17 or a composition comprising the same in the form of a film, at least one layer of a multilayer film, at least one layer of a laminated article, a foamed article, a fiber, a nonwoven fabric, an injection molded article, a blow molded article, a roto-molded article, or an adhesive.

23. A copolymer according to claim 1 or 2 wherein the shuttling agent is a trihydrocarbyl aluminum- or dihydrocarbyl zinc- compound containing from 1 to 12 carbons in each hydrocarbyl group.

24. A copolymer according to claim 23 wherein the shuttling agent is triethylaluminum or diethylzinc.

25. A copolymer according to claim 1 or 2 wherein catalyst (A) comprises a complex comprising a transition metal selected from Groups 4-8 of the Periodic Table of the Elements and one or more delocalized, π -bonded ligands or polyvalent Lewis base ligands.

26. A copolymer according to claim 25 wherein catalyst (A) corresponds to the formula:



, wherein:

T^3 is a divalent bridging group of from 2 to 20 atoms not counting hydrogen; and

Ar^2 independently each occurrence is an arylene or an alkyl- or aryl-substituted arylene group of from 6 to 20 atoms not counting hydrogen;

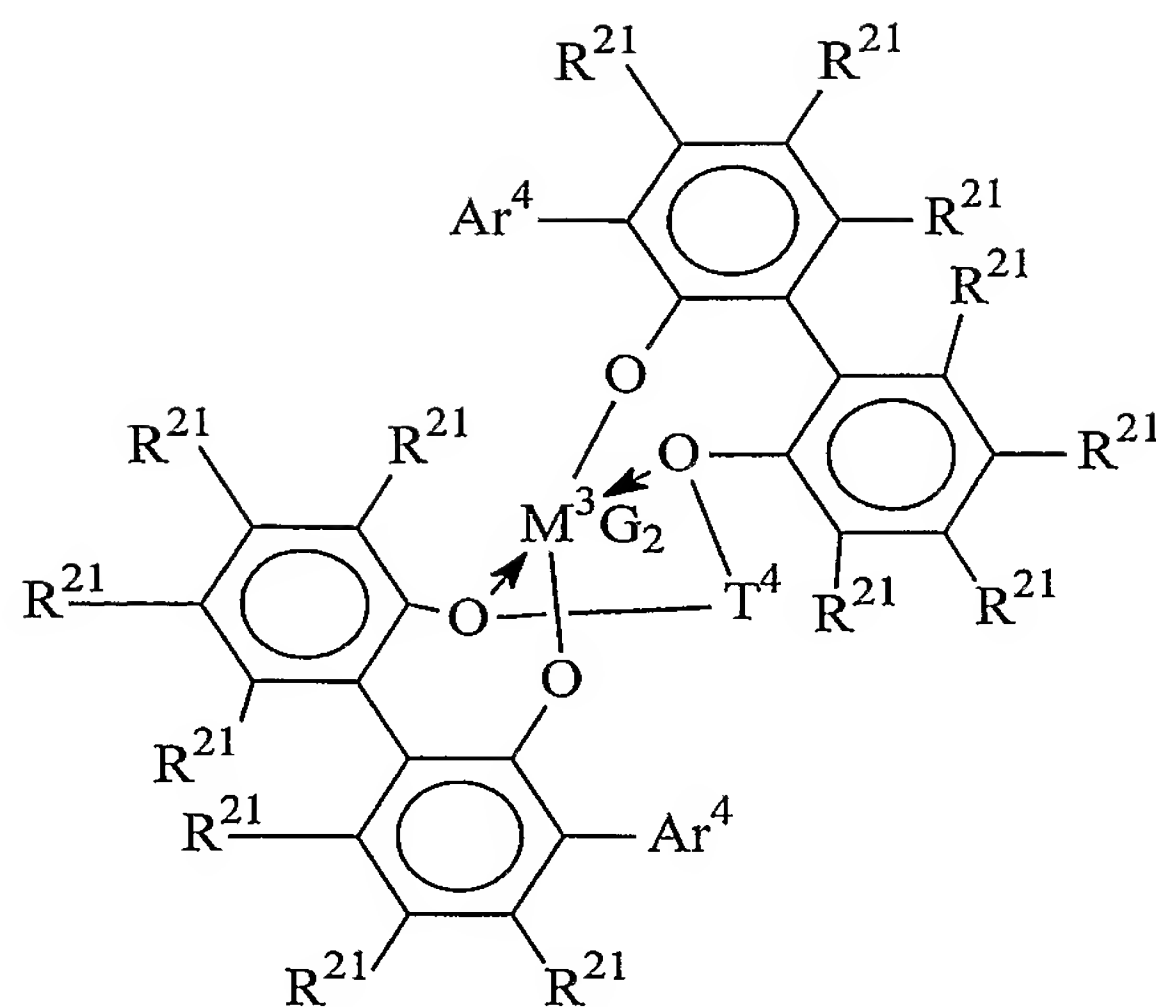
M^3 is a Group 4 metal;

G independently each occurrence is an anionic, neutral or dianionic ligand group;

g is a number from 1 to 5 indicating the number of such X groups; and

electron donative interactions are represented by arrows.

27. A copolymer according to claim 23 wherein catalyst (A) corresponds to the formula:



where M^3 is Hf or Zr;

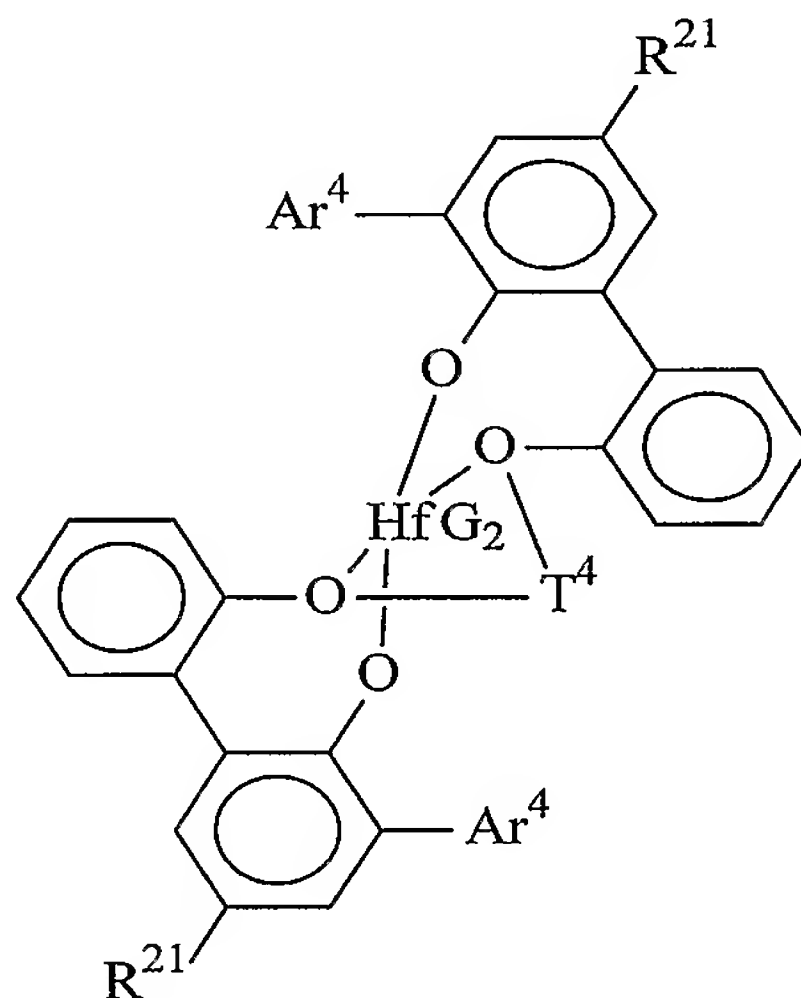
Ar^4 is C_{6-20} aryl or inertly substituted derivatives thereof, especially 3,5-di(isopropyl)phenyl, 3,5-di(isobutyl)phenyl, dibenzo-1H-pyrrole-1-yl, or anthracen-5-yl, and

5 T^4 independently each occurrence comprises a C_{3-6} alkylene group, a C_{3-6} cycloalkylene group, or an inertly substituted derivative thereof;

R^{21} independently each occurrence is hydrogen, halo, hydrocarbyl, trihydrocarbylsilyl, or trihydrocarbylsilylhydrocarbyl of up to 50 atoms not counting hydrogen; and

10 G , independently each occurrence is halo or a hydrocarbyl or trihydrocarbylsilyl group of up to 20 atoms not counting hydrogen, or 2 G groups together are a divalent derivative of the foregoing hydrocarbyl or trihydrocarbylsilyl groups.

28. A copolymer according to claim 23 wherein catalyst (A) corresponds to the formula:



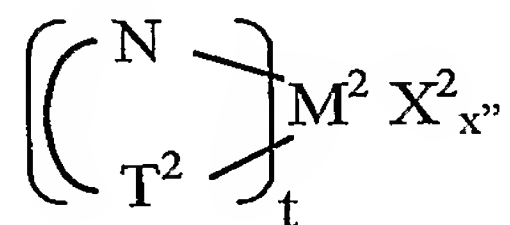
15 wherein Ar^4 is 3,5-di(isopropyl)phenyl, 3,5-di(isobutyl)phenyl, dibenzo-1H-pyrrole-1-yl, or anthracen-5-yl,

R^{21} is hydrogen, halo, or C_{1-4} alkyl, especially methyl

T^4 is propan-1,3-diyl or butan-1,4-diyl, and

G is chloro, methyl or benzyl.

29. A copolymer according to claim 1 or 2 wherein catalyst (B) corresponds to the formula:



wherein

M^2 is a metal of Groups 4-10 of the Periodic Table of the elements;

T^2 is a nitrogen, oxygen or phosphorus containing group;

X^2 is halo, hydrocarbyl, or hydrocarbyloxy;

t is one or two;

x'' is a number selected to provide charge balance;

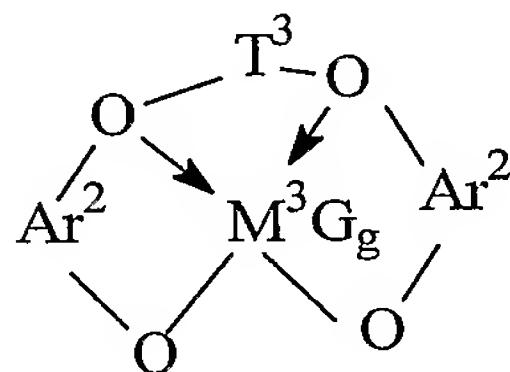
and T^2 and N are linked by a bridging ligand.

30. A process according to claim 3 or 4 which is a continuous process.

31. A process according to claim 30 which is a solution process.

32. A process according to claim 30 wherein propylene and ethylene or 4-methyl-1-pentene and ethylene are polymerized.

33. A process according to claim 30 wherein catalyst (A) corresponds to the formula:



, wherein:

T^3 is a divalent bridging group of from 2 to 20 atoms not counting hydrogen; and

Ar^2 independently each occurrence is an arylene or an alkyl- or aryl-substituted arylene group of from 6 to 20 atoms not counting hydrogen;

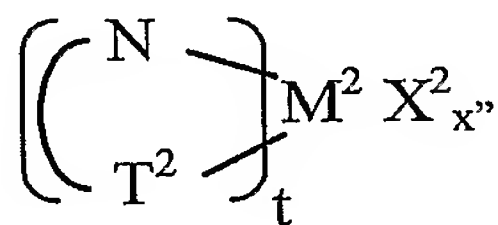
M^3 is a Group 4 metal;

G independently each occurrence is an anionic, neutral or dianionic ligand group;

g is a number from 1 to 5 indicating the number of such X groups; and

electron donative interactions are represented by arrows.

34. A process according to claim 30 wherein catalyst (B) corresponds to the formula:



wherein

M^2 is a metal of Groups 4-10 of the Periodic Table of the elements;

T^2 is a nitrogen, oxygen or phosphorus containing group;

X^2 is halo, hydrocarbyl, or hydrocarbyloxy;

t is one or two;

5

x'' is a number selected to provide charge balance;

and T^2 and N are linked by a bridging ligand.